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AND

TREE CULTURE ON WATER FRONTAGES

BY

D. HOWITZ, Esq.

FOREST CONSERVATOR, COMMISSIONER FOR DENMARK

LONDON

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International Fisheries Exhibition

LONDON, 1883

FOREST PROTECTION

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TREE CULTURE ON WATER FRONTAGES

WITH THE VIEW OF

PROVIDING A CONSTANT AND STEADY SUPPLY
OF WATER, FOOD, SHADE, AND SHELTER,
FOR FRESHWATER FISH

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1883



International Fisheries Exhibition.

LONDON, 1883.

CONFERENCE ON WEDNESDAY, JULY 18, 1883.

HIS Excellency M. DE FALBE took the chair, when the following paper was read by Mr. HOWITZ on

FOREST PROTECTION AND TREE CULTURE ON WATER FRONTAGES, WITH THE VIEW OF PROVIDING A CONSTANT AND STEADY SUPPLY OF WATER, FOOD, SHADE, AND SHELTER FOR FRESHWATER FISH.

THE questions of pisciculture, its protection, and the protection of fisheries have been already discussed by so many able and learned gentlemen, that I should not have ventured to come forward if there had not presented itself to my mind a question in which I, as a professional forester, have a great interest, and one which I feel is of much importance to the success of pisciculture and to all freshwater fishing.

The value of the question which I have the honour to bring before you may not at first appear so great as it really is, but, while endeavouring to enlist your sympathies, I do so in the sincere hope that by the introduction of it at this Conference it may become a question of interest to all and a special subject for future legislation. It is the question of the protection, proper management, and cultivation of

forests and forest trees in localities where are found the sources of creeks, rivers, and the supply of water to lakes and other fresh waters.

For Great Britain this question has its greatest significance with regard to future forest culture on barren heights and the cultivation of shade and shelter trees along water-courses. The greatest part of the forest land with which our question has to deal is in the possession of large land-owners, but as far as I can ascertain there are no laws in existence giving a guarantee for the preservation and proper management of these forests. Far more importance has this question for the British Colonies, America, and several other countries, where either the State, a number of persons, and in some cases nobody, owns the land in question.

That the forests regulate the flow of the water in water-courses, and ensure a steady supply during dry seasons, while they prevent sudden and disastrous floods, is a fact so often discussed and proved, that I need only refer to it here.

That the forests also increase the rainfall has often been disputed, and this question has of late years received considerable attention, particularly in France, but there is still a great deal of uncertainty about the exact extent of the effect of a forest on the rainfall, and it is only by very minute observations of forests, consisting of the same species of trees in various altitudes, that series of trustworthy results can be attained. Still there is no longer any doubt as to the effect of the forest in conserving the water that falls, or that the humidity of the air above a forest is considerably larger than that of the air of the open country. Experiments in the South of France showed that the rainfall in a forest as compared with that in the open country was in the propor-

tion of 100 to 92·5, while the evaporation in the forest was only one-third of the evaporation in the open. The result of this is that the actual water received and retained from the atmosphere is nearly fifty per cent. greater in a forest than that received and retained by the plains. Numerous observations have also established the fact that the forests, as ready conductors of electricity, influence the current of vapours, and that their action is felt far above the actual height of the trees. Also that they condense the clouds into rain by lowering the temperature, and act as bulwarks against the severity of storms ; all this we know by daily experience and observation. That want of forest protection may have most fearful results has been so often and sadly proved, and I need only remind you of the disasters caused by great floods and long droughts in Spain, South of France, Sicily, Chili, Peru, Mauritius, and many other places, and you will grant the importance of the question. In the Murcia valley the river was reduced to a succession of stagnant pools, which during the summer heat developed malaria, fever, and miasmatic exhalations, detrimental to life and health, and furnishing but scant and bad accommodation for the few remaining fish. But as soon as the winter rains came, the river, in fact nearly all the valley, became a raging torrent, destroying life and property, and all because the forests on the ranges and mountains had been devastated, no legal restrictions protecting them. As a question of national economy, as a question of protection to life and property, and as a question of prosperity, forest protection has therefore the greatest claim to the attention of the Legislature. But to us as a means of yielding a constant supply of water, food, and shelter for the fishes, it has also great significance. The forest, with its numberless roots and

decaying vegetation, retains the rain water and prevents it from rushing to the rivers and the sea, while it gives it off to these slowly and steadily. It acts like a great sieve and retains the fine particles of the soil, which the influence of the air and sun, the frost and rain, and the action of the numberless roots have decomposed, thereby fertilising the land and forming a layer of mould or humus, in which insects, worms, larvæ, and other animalcules live and breed.

In his most interesting paper on fish diseases, Prof. Huxley said that drought or flood did not seem to affect the *Saprolegnea*, but that a steady flow was beneficial to the fish.

Mr. Wilmot, in the following discussion, pointed out that the disease nearly always appeared where the regularity of the supply of water had been disturbed by the destruction of the forests.

I presume, therefore, that both these learned and practical gentlemen will agree with me in the importance of the forest protection as a means of preserving the health of the fishes.

The branchlets, leaves, decaying and decayed vegetation, produce a vast amount of nourishment for the fish, and one most agreeable to them. Each breeze drops into the water numberless grubs, caterpillars, beetles, flies, and other insects, the food most relished by the fishes, while from the banks and roots worms and grubs are constantly supplying them with delicacies.

The shade of the overhanging trees is also agreeable to the fish, and one needs only place a board in a stream and see the fish gather underneath it to be convinced of this. We all know that a shady deep pool is a good place in which to seek for fish, and have often observed the predilection fish have for the shady side of a stream. But not

only as regards freshwater fishing can this be said. In Denmark it is a well-known fact that the best fishing is where a forest is close to the shore, and in particular where the trees, as is often the case in that country, overhang the very sea. The shadowing trees have another and, perhaps, the far more important effect of preventing a large evaporation, and at the same time keeping the water clear and cool in summer, while on the same account the winter frosts do not deal so severely with them. In all forest country the changes of temperature are not so severely felt as in a treeless country or on the open plains, and the effect upon the water is even greater. It is a popular saying in Denmark of the forest streams, that they are cool in the summer and warm in the winter, this, of course, meaning that they present that feeling in comparison to the atmosphere. The forests not only regulate the flow of the water, but they purify the water. This is an experience often demonstrated in Australia in cases where streams have been polluted by wool-washing establishments. After having passed a few miles through a shady and dense forest the water will appear as clear and pure as it was above the woolwash.

I need not here enter upon more reasons for the conservation of existing forests to ensure a steady supply or to draw your attention to the danger in not protecting them by legislation. But I will draw your attention to the advisability of cultivating forests on places suitable for the supply of water, and especially along watercourses and lakes as means of purifying these, preventing too great evaporation, supplying food for fish, and providing these with shade against the rays of the summer sun, and shelter from the pelting rains, the hail and the tempests.

Salmon fishing and all freshwater fishing depend upon

proper attention to this matter, and I feel certain that if the true causes were properly investigated where fish were said to disappear from a stream, in half the cases it would be found that the shade and shelter of the forests or protecting border trees had been taken away. It was said at the reading of Sir James Gibson Maitland's excellent paper on the "Salmonidæ," that it was not enough to place spawn and fry in a water, they must be provided with proper food, and the best means to do this is to preserve the border trees and ensure a steady supply of water and food by preserving the forests from whence the supply of water is derived. But, as before remarked, it is not enough to preserve the present forest. New forest must be cultivated on the barren ranges, and many a stream, now nearly empty during dry seasons, will be re-filled and soon teem with fish and food for the many. So far for the principle of the conservation of the forest. I will now briefly mention the most suitable trees and their culture. But before entering upon this, I must draw your attention to the important condition to be observed in the management of such forest areas, as are preserved for the sake of conservation of water. *This condition is density.* In the dense shade of a well-closed forest are developed all those atmospheric conditions on which depend the greatest effects of the forest in regard to climate and water conservation. The so-called periodical thinning out in these areas should be carried on with the greatest care, and might with advantage be nearly dispensed with, if the economy of the management would permit it. The result would be, besides the effect upon the water conservation, that tall straight trees would be reared, yielding timber most valuable for all practical purposes. Nature itself would do the thinning out, and do it in a better way than we could hope

to do, while the ground would be kept moist and in a state favourable to the decomposition of vegetable matter. It is desirable therefore to frame regulations regarding such forests, deciding the minimum to be preserved of the number of trees per acre, due regard being of course paid to age, species, altitude, and locality. For these reasons it is highly important that *all such forests*, whether private property, commons, or belonging to the State, *should be placed under the control of the State.*

The different trees have naturally a different effect as regards conservation of water and production of food and shelter for fish, as I will here briefly point out. To simplify matters we may divide all forest trees into two large groups, the deciduous and the evergreen trees. The deciduous trees, of which, as far as Great Britain is concerned, the oak, elm, beech, plane, larch, willow, and poplar are the most prominent, have a decided advantage over the evergreens. I need not here enlarge upon the fact that the full shady foliage during the summer is far more effective in preventing a large evaporation, and that the branches of the trees of this group are more spreading than those of the other. The energy of life seems to be far greater in these trees towards effecting our objects, and for direct border trees to a watercourse they are undoubtedly the best suited. The great amount of foliage and branchlets yearly thrown by these trees forms a very prominent factor in the economy of nature, and their decaying vegetation is full of teeming life and food for fish.

That this group is eminently suited for water conservation, was illustrated in a forest in Denmark, where an area of firs and pines was cultivated with beech and oak. After a lapse of about fifteen years a millstream, which during the time of the evergreen trees had dwindled down con-

siderably, assumed such proportions that the irrigation of a considerable area was effected by it, besides supplying the mill with abundance of water. As regards the ever-green trees, the first cultivation of barren ranges or high plateaus might advantageously be undertaken with these on account of their ability to resist the severity of the climate in those exposed localities, and to grow on stony and poor soil. But even on rocky ground and in high altitudes the larches, birches, and other deciduous trees will often do well and serve better for the end which we have in view, the water storage and the pisciculture.

In such localities, where only the most hardy trees can be reared, it would be practical to cultivate along the watercourses, in the valleys and ravines, or any lower ground, a few rows of deciduous trees as soon as the other trees had attained sufficient height to protect them from the storms and the frosts. Several objects may be gained by doing so. First, the shade, shelter, and other beneficial effects for the fishes ; secondly, that more valuable timber could be reared, as these trees have, as a rule, a greater preference for damp and moist localities than the ever-greens ; and, thirdly, because the deciduous trees permit more freely a luxuriant undergrowth of shrubs and annuals. All freshwater fishermen will agree with me in the advantage of having a good growth of annuals as watercresses, nettles, &c., near the bank, and have observed that during feeding time the fish always seek such places. There is a vast variety of shrubs and annuals, that might easily and with great advantage be introduced and grown on the river banks, but it would be outside the bounds of this paper to enter fully on the theme. However, I may only mention that many fodder plants and grasses from other countries might be a source of wealth to the popu-

lation, and greatly benefit the fish as well as the owners of the land, if cultivated on the banks. The Prickly Comfrey, e.g. (*Symphytum asperrimum*), which yields such a splendid forage by its abundant foliage, and many others, are easily reared both from seed and cuttings, and should do well in the low lands, while on the sandy beaches, near the outlet of rivers and creeks, the cabbage radish (*Pringlea antiscorbutica*) would cover these barren and desolate places with vegetation, and furnish an object of merchandise by packing them for the use of fishermen and sailors in the Arctic regions. The plant when cooked is a good substitute for cabbage, and has a most wholesome effect on persons suffering from scorbutica.

By a judicious forest management, which I will not enter upon here, the land can be kept covered constantly, and always in a state favourable to the purpose of storing the water. That many of the evergreen trees may be of great importance, and particularly where they are better suited to clime and soil, I will not deny. The Australian eucalypts, which have such a beneficial effect on the health of man, may also serve well for pisciculture, but as far as I know, no experience is yet at hand with regard to this. Still I doubt if these trees might not do more harm than good by being planted on watercourses, on account of their great drying properties. In warmer countries, the place for these trees is where stagnant waters during summer are breeding places for fever and ague. The cultivation of the borders of watercourses has also a great significance to us, and it is here that the deciduous trees must be mainly utilised. The belt need not be very broad, say half a chain wide, and planted with good-sized plants at the rate of from 800 to 2000 per acre, according to their age. Even a double row of trees would be a benefit, but it is important

that both sides of the stream should be planted instead of cultivating twice the distance on one side. This being done with the object of providing a perfect shelter in some place, and valuable observations may be obtained by doing so. A great many American and other foreign trees might well be introduced, as, for example, the Swamp Cypress (*Taxodium distichum*), a great tree yielding a finely-grained timber, hard and durable, and the Leverwood tree (*Ostrya Virginica*), which besides excellent timber furnishes a relished forage from its rich foliage; these, and a great many more, might have a good effect on the river fishing besides other advantages. But it is particularly the willows to which our attention should be drawn. The preference which these trees have for water, and particularly for running water, is well known, and points directly to the practicability of placing them in those localities so well suited for them. The fish like willows, and I have often times in Australia seen the best fishing places close to where some weeping willows (*Salix Babylonica*) had taken the place of the indigenous and even more shady wattles (*acacias*).

The yearly consumption of osiers in England is far greater than the national supply, and as the basket industry is constantly on the increase, it would also on this account be advisable to further the cultivation of the osier willows. For light, sandy banks, the best willow should be *Salix Purpurea*, and, as it is so easily propagated, it will well repay the cost of cultivation, besides binding the banks, making them firm, and adding to the health of the locality as well as that of the water. For more clayey soil, *S. viminalis* and the now celebrated *S. capræa*, so much sought for powder factories, should be the best. The cuttings must be taken from the one to two year old shoots, and be put 1 to 1½ foot apart, in double or treble

rows 2 to 3 feet apart, care being taken to leave only $\frac{1}{2}$ inch or less above ground.

There are many localities where comparatively valueless land, close to the mouths of rivers and canals, might be made highly profitable, at the same time as the cultivation of it with the before-mentioned trees and plants would improve the state of the fishing, and, before placing spawn and fish in any water, I consider it important to pay great attention to this question. Where few or no trees exist it will be necessary to cultivate them, and I feel certain that such proceeding will enhance the chances of the success of pisciculture. I will not here enter further upon the practical details of the question. These are bound to vary with the locality, and the local foresters will know how to deal with them.

In drawing the attention of the Conference to this question, it is with the sincere hope that it may enlist your sympathy, and that the public opinion may be won for it. That it is important for all freshwater fishing is evident. That is one more reason added to the many why we should regard the forest as a precious heirloom to be deeply revered, properly used, and, through careful maintenance, descend improved and enriched to posterity.

DISCUSSION.

Professor BROWN GOODE moved a vote of thanks to the Danish Commissioner for the Paper. He had already that day, in speaking on Professor Lankester's paper, called attention to the fact that one of the most important results of the Exhibition was its scientific results, important among which are the Conference Papers which have been read. This was confirmed by the present paper, which

touched on an entirely new question. Hitherto the literature of fish culture had contained no allusion to forest culture: at the same time it was a subject of great importance, and every fish culturist would see the bearing of it at once. Mr. Howitz had pointed out this fact, and had given them the benefit of his practical experience as a forester in Australia, and while engaged by the French Government in the forest service in Algiers. He considered that this paper would be received with great interest by his own countrymen, because in the United States, more than in any part of Europe, had the destruction of forests taken place. Many streams which formerly had a steady flow of water were now dried up in summer, and torrents in winter, while many kinds of fish which once teemed in them were now almost extinct.

Major SEWELL-GANA seconded the motion, which was carried unanimously.

The MARQUIS OF HAMILTON proposed a vote of thanks to his Excellency the Danish Minister for so kindly presiding over the meeting. He regretted the attendance had been somewhat small, but it must be a matter for congratulation to Mr. Howitz that his paper had been so thoroughly appreciated by the United States Commissioner. It was also a matter for congratulation to think that a gentleman of Danish nationality should be so kind as to come and preside on the present occasion, and that another Danish gentleman should be so good as to read this important paper, especially remembering that both were of the same race as the noble lady who was so much beloved in England—the Princess of Wales. His Excellency had taken great interest in the Exhibition from its commencement and it was owing to him and to Mr. Howitz that the Danish Court had been so amply filled.

Mr. WILMOT seconded the resolution. There was no doubt that this paper was of a novel character as connected with fish culture, for he was quite aware that it had not been discussed before in any public manner, but he might be pardoned for mentioning that on two or three occasions on sending reports to the Government of Canada he had expressed his views that the clearing of the forests had been one of the principal causes of the destruction of salmon in the Province of Ontario. He could speak from experience in the matter, on account of salmon being very numerous in a stream that ran through his property. Before the forests were cleared off, salmon and the better kinds of fishes were there in vast numbers, but as the trees were cleared off the water changed its temperature, it became less in quantity, and the consequence was they had lost all those valuable fish. He should not attribute it wholly to the want of trees, but that had been one of the principal agencies. Man, with his destructive engines, had of course aided by killing the parent fish when laying its eggs in those streams, but there was no doubt that the want of sufficient shade and coldness of the water for the fish to live and breed, was also an important element, because these higher breeds of fish were always found in cold waters. So important was it, that for the last two or three years he had set out a large number of trees round the pond where he was carrying on fish culture, and found it very beneficial, and he had often noticed the fish run underneath the shade of the trees on hot days, the temperature being lower there than out in the open stream. He had always contended that farming, forestry, and fish culture should go together, because one aided the other. Forestry aided agriculture, because if the whole forest was cut away the rainfall was interfered with, and

agriculture was more or less affected. There were localities in Canada where forests had been wholly destroyed, where now they were unable to raise the same kind of grain as in former years ; therefore it was evident that the total clearing of forests was injurious to agriculture. He was very glad that this paper had been read, because it would now be spread abroad and carry authority with it, and would no doubt do a vast deal of good. In his opinion, forests were useful in filtering the water which passed into the stream. The trees themselves filtered it, and so did the leaves on the ground, and the water was more pure than when it fell direct on the soil and ran straight into the river. There was no need to interfere with cultivated land, but rows of trees might be planted by the side of streams, which would not affect farming operations, and would conduce to the growth of fish. There was no doubt that the greater amount of forests on the face of the earth the greater the rainfall. Last year the legislature of the province of Ontario passed an Act incorporating a forestry association, the object of which was to set out trees for the benefit of the country, and preventing the destruction of those around the fields and along the sides of the roads.

The vote of thanks having been passed unanimously,

The CHAIRMAN said he had had much pleasure in taking the Chair, and he begged to acknowledge the kindness with which he had been received, not only there, but on every occasion since he had come to England as Danish Ambassador.

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